Chemical & Engineering NEWS
December 7, 1981

Process control equipment thrives in poor economy

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Program for 1982 Pittsburgh Conference & Exposition Atlantic City, N.J. Page 47

05111790092 9 N AR594951 1466
CONGRESSIONAL INFO SERV
4520 EAST WEST HWY SUITE 300
BETHESDA MD 20814

December 7, 1981
Volume 59, Number 49
CENEAR 59 (49) 1–88
ISSN 0009-2347

Chemical & Engineering NEWS

Cover: Control center of PPG Industries' Lake Charles, La., power plant, one of three that together generate about 75% of electrical requirements for the company's large chemical complex there. As an energy-saving measure, one generator is partly fueled by hydrogen gas produced as a by-product of chlorine manufacture

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- ***Present and future needs for stable isotopes*** *and derived radioisotopes is the subject of a workshop to be held at the National Academy of Sciences.* ***Page 9***
- ***Interferon,*** *potential anticancer and antiviral agent, increases damage done by some viruses in mice by concentrating the infection in the brain.* ***Page 9***
- ***John Harvey-Jones,*** *former product director of fibers division and of heavy organic chemicals division, named chairman of Imperial Chemical Industries.* ***Page 9***
- ***New hydrometallurgical process*** *to extract gold from a variety of ores will be developed by Haber in joint venture with a Houston mining firm.* ***Page 10***
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Technology

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CHEMICAL CAPITAL SPENDING STILL SLUGGISH

Despite a pickup in the third quarter, U.S. chemical companies' capital spending on new plant and equipment—their largest outlay of funds after ordinary running expenses and taxes—is turning in a sluggish year. The money is up, but it helps to wink at inflation.

Fresh data from the Conference Board, a New York City business research group, show a stronger tone to capital spending in the third quarter than in the first half of 1981. However, the strengthening only brings the industry close to its own predicted spending rate for the year, which is decidedly soft.

The Conference Board finds that chemical capital spending through nine months of 1981 is up 7% from the same period in 1980. That's pretty close to the 8% pickup for 1981 that basic chemical companies projected at the end of last year (C&EN, Dec. 8,1980, page 19). And it is higher than the 4% gain in actual spending for the first half of the year (C&EN, Sept. 7, page 15).

However, a 7% gain in capital spending barely keeps up with inflation. In other words, in physical project terms the industry's plant investment rate flattened out in 1981.

Specifically, the Conference Board reports that chemical capital spending in the third quarter in current dollars hit $3.16 billion, 9% more than in the third quarter last year. This brings capital spending for the first nine months 7% ahead of spending for the same period in 1980.

In constant 1972 dollars, the chemical companies surveyed by the Conference Board spent $1.62 billion in the third quarter, an increase of just 4% from the third quarter last year. The constant-dollar spending increase is a mere 1.1% for the year.

One capital expenditure: fractionating column on way to B. F. Goodrich plant

Appropriations (money to be spent in the future), like spending, picked up in the third quarter. Current-dollar appropriations by chemical companies increased 24.5% to $3.39 billion from the same period last year. However, this runup in the third quarter served only to get appropriations back on track for the year. For the first nine months, appropriations were only 4.4% ahead of the first three quarters of 1980.

Constant-dollar appropriations, in spite of a rise in the third quarter, still are losing ground for the year. Third-quarter constant-dollar appropriations increased 18.4% from the same period last year to $1.74 billion. However, for the nine months to date, constant-dollar appropriations are off 1.6% from their levels of a year ago.

The backlog of unspent appropriations also increased at the end of the third quarter, as it has for some time because of restrained spending. The current-dollar backlog of $9.64 billion at the end of the quarter was 5.1% greater than at the end of the third quarter last year. It was also 1.7% ahead of the $9.48 billion backlog at the end of second-quarter 1981.

In constant dollars, the backlog in the third quarter was $9.43 billion, 2.7% ahead of last year and 0.9% greater than in second-quarter 1981.

For the rest of 1981, capital spending prospects could be worse, in light of the falling economy. With their cash intake pared, chemical companies may well take a second look at some spending projects. And for 1982, the outlook is for more of the same at best. □

Rates of chemical capital spending and appropriations both increased in third quarter

	1981			1980					
$ Millions	Third quarter	Second quarter	First quarter	Fourth quarter	Third quarter	Second quarter	First quarter	% annual change, third quarter	% annual change, first nine months
Appropriations									
Current dollars	$3389	$3038	$2939	$3193	$2723	$3201	$3043	24.5%	4.4%
Constant dollars[a]	1737	1610	1568	1696	1466	1789	1742	18.4	−1.6
Spending									
Current dollars	3158	2751	2856	2714	2898	2681	2613	9.0	7.0
Constant dollars[a]	1618	1458	1526	1442	1560	1499	1495	3.7	1.1
Backlog[b]									
Current dollars	9641	9480	9417	9819	9173	9362	8855	5.1	5.1
Constant dollars[a]	9431	9348	9315	9529	9096	9288	9005	2.7	2.7

a 1972 dollars. b Backlog of unspent appropriations at end of period. **Source:** Conference Board

Process control equipment ignores recession

Energy management steps, retrofitting of existing plants tide control equipment makers over slowdown in new plant construction

Stephen C. Stinson
C&EN, New York

If there's an economic recession going on in the U.S., the makers of industrial process control equipment don't know it yet.

For example, a study of process control equipment markets by Predicasts, based in Cleveland, indicates that dollar sales of such equipment have forged ahead at 5% annual real growth for the past 15 years, a trend that seems likely to continue unbroken through 1985 and beyond.

Even this solid dollar growth, which is almost double the yearly increase in the gross national product, understates the health of some market segments. A second study by Creative Strategies, San Jose, Calif., concludes that unit sales of some digital electronic equipment will soar 25% per year through 1985, though continuing declines in the prices of electronic devices will slow dollar growth.

The reason for this successful bridging across bad times in manufacturing industries is that most firms continue upgrading materials, energy, and labor use efficiencies at existing plants, even if they're building few new plants.

The future looks even brighter. In addition to a return to new plant construction with economic recovery in coming years, synthetic fuels projects could start using a lot of costly instrumentation and control. Initial fears that withdrawal of government support from synfuels would force cancellation of many projects now seem overpessimistic. Private industry is picking up the slack for many of these projects.

The U.S. chemical industry will continue to buy a quarter of all process control equipment sold in this country. Chemical purchases will rise from $1.2 billion in 1981 to almost $2 billion in 1985, according to Predicasts, which assumes a 7% annual inflation rate.

The next largest purchaser, in terms of dollar volume, is the oil industry, whose $860 million of process control purchases this year will be 14% of the market. Oil companies will buy $1.5 billion worth in 1985, says Predicasts analyst Dean M. Peters, raising their share to 18%.

Fastest growing in use of process control equipment is the rubber and plastics industry, where automation of such operations as injection and blow molding, extrusion, and compounding will double this year's $50 million in orders by 1985.

Process control equipment includes computers and programable controllers; temperature, pressure, flow rate, and liquid level sensors, transmitters, and controllers; materials analyzers; and valves. Sales of electronic sensors, transmitters, and

Electronic devices will show biggest growth over the next few years

Control equipment	Sales[a] ($ millions) 1981	1985	Annual growth rate, %[b]
MEASUREMENT, DISPLAY & CONTROL	$3721	$ 5,900	12.2%
General purpose[c]	**403**	**630**	**11.8**
Electronic	296	470	12.2
Pneumatic	107	160	10.5
Process control computers	**733**	**1,130**	**11.4**
Temperature instruments	**597**	**950**	**12.3**
Electronic	296	510	14.6
Mechanical	92	130	9.0
Primary temperature sensors	209	310	10.3
Pressure instruments	**301**	**470**	**11.8**
Electronic	100	170	14.1
Mechanical	200	300	10.6
Flow & level instruments	**676**	**1,090**	**12.7**
Differential pressure	302	480	12.3
Electronic	139	250	15.8
Other	235	360	11.3
Material analysis equipment	**265**	**420**	**12.2**
Chromatographic	58	90	11.7
Infrared	64	100	12.0
Oxygen analyzers	55	90	13.0
pH and other instruments	89	140	12.1
Other instruments, parts & accessories	**$ 746**	**$ 1,210**	**12.8%**
Other physical variables	89	130	10.0
Parts & accessories	658	1,080	13.2
PROGRAMABLE CONTROLLERS	**330**	**1,000**	**32.0**
VALVES	**1401**	**2,210**	**12.1**
Control	**676**	**1,070**	**12.2**
Pneumatic	442	680	11.4
Electric	103	170	13.3
Electric/hydraulic	30	60	19.4
Other	102	160	12.1
Regulating	**490**	**770**	**12.0**
Pressure	234	380	12.9
Flow	149	230	11.5
Temperature	36	50	8.4
Other	71	110	11.7
Solenoid	**235**	**370**	**12.0**
Two-way	178	280	12.0
Other	57	90	12.1
TOTAL SALES	**$5452**	**$ 9,110**	**13.7%**
Less imports	**$ 216**	**$ 380**	**15.1%**
Plus exports	**$ 758**	**$ 1,350**	**15.5%**
TOTAL SHIPMENTS	**$5994**	**$10,080**	**13.9%**

a Amounts do not add to totals and subtotals because of rounding. b Includes a 7% per year estimate for inflation. c Includes controllers, indicators, and recorders for control rooms.
Source: C&EN calculations from Predicasts data

Chemical industry buys 25% of all process control equipment

Industry	Sales[a] ($ millions) 1981	1985	% growth rate[b]
Chemicals	1214	1980	12.3
Petroleum	857	1500	15.0
Electric & gas utility	786	1360	14.7
Primary metals	732	1220	13.6
Paper & pulp	352	510	9.7
Food & beverage	341	550	12.7
Stone, clay & glass	182	280	11.4
Water & sewage	104	160	11.4
Textiles	59	110	16.7
Rubber & plastics	49	100	19.3
Mining & other[c]	235	370	12.0
TOTAL SALES	$4911	$8140	13.3%
Net exports[d]	$ 541	$ 970	15.7%
TOTAL SHIPMENTS	$5452	$9110	13.5%

a Amounts do not add up to totals because of rounding. b Includes a 7% per year estimate for inflation. c Includes foundry and pharmaceutical industries. d Excess of exports over imports. Source: C&EN calculations from Predicasts data

controllers will grow at faster rates than pneumatically operated ones, Peters says, because of greater ease of use with computers, microcomputers, and microprocessors in such concepts as hierarchical and distributed control. Indeed, some equipment producers are moving away from pneumatic controls, especially in Europe, where a return from the currently depressed market is expected to emphasize electronic controls.

Still, pneumatic equipment will fill definite major roles through the end of the century. For example, where compressed air service already exists at a plant site, economics may favor continuing with pneumatics. Too, some managers are prejudiced against outlying electronic devices in plants that process flammable or other hazardous materials. Pneumatic signals also can be converted to electronic signals, thus making possible use of computers in plants with pneumatic controls.

But at least one argument against electronic controls may not hold up. This argument turns on the greater cost of individual pieces of electronic equipment compared to pneumatic equipment. Industry observers counter that the installed costs of each still favor pneumatic approaches, but not by very much.

Though about 1000 firms serve the process equipment control market, Predicasts points out that a handful of U.S. companies have most of the business. Only a few of these are publicly held companies and release financial information. Among these publicly held firms, process control sales cut across many divisions and are difficult to separate. C&EN has estimated 1980 sales of the leaders where these were unavailable or hard to isolate.

The apparent sales leader is Honeywell of Minneapolis, whose 1980 sales are estimated at $670 million. Second is Fisher Controls International, a joint venture company formed in 1979, owned 67% by Monsanto and 33% by General Electric Co. Ltd. of the U.K. (unrelated to the U.S.'s General Electric). Fisher sold $593 million worth of process control equipment in 1980. Third ranked is Foxboro Co., Foxboro, Mass., whose sales of process control equipment last year came to $484 million. Predicasts says that such sales are 95% of Foxboro's total.

Hewlett-Packard, Palo Alto, Calif., is fourth; its 1980 process control equipment sales are estimated at $394 million. Fifth is Texas Instruments, Dallas, which likewise does not break out process control equipment sales, but which C&EN estimates at $316 million in 1980. These five largest firms among the top sellers to the industrial process control equipment market probably accounted for 35% of sales to the U.S. and world markets.

Less clear are the standings of the next five largest sellers of industrial process control equipment. Gould of St. Louis sold about $252 million of equipment in 1980. General Electric (the U.S. company) sold about $245 million worth. Sales of Westinghouse are estimated at $270 million. Taylor Instrument, subsidiary of Sybron Corp., Rochester, N.Y., sold about $195 million, in addition to $20 million of consumer instrument sales. Rosemount Instruments, Fullerton, Calif., presently the object of acquisition by SmithKline Corp. (C&EN, Nov. 30, page 8), sold about $195 million. The 10th largest company in size of process control instrument sales, Fischer & Porter, Warminster, Pa., sold $170 million worth, in addition to $15 million of other products to other industries.

Supplying the industrial process control equipment market is a fairly profitable business. Foxboro's earnings were 6.3% of sales in 1980, 7.2% in 1979, and 8.1% in 1978. A company supplying this industry must put a certain amount of profits into development of new equipment for coming years, in addition to paying out dividends, so that it can keep abreast of technology and maintain a steady pattern of earnings over the long-term.

Monsanto revealed that Fisher Controls had an operating profit of 12% of sales in 1980 and 9% in 1979. If one assumes a 50% share for income taxes, these figures might have been equivalent to net earnings of 6% of sales in 1980 and 4.5% in 1979. Thus, these results would not be too much different from Foxboro's.

Similarly, Sybron indicated equivalent net earnings of 3% of sales for Taylor Instrument in 1980, 3.2% in 1979, and 5.3% in 1978, likewise assuming income taxes of 50% on operating profits. Besides Foxboro, the only major independent, publicly held process control equipment producer is Fischer & Porter, which reported net earnings of 9.6% of sales in 1980, 0.5% in 1979, and 3.1% in 1978. Spokesmen for Fischer & Porter blame low earnings on high interest rates and strength of the dollar, which has increased overseas prices of U.S. exports and lowered dollar values of profits brought back to the U.S.

In addition to Monsanto, companies that have experience specifying process control equipment for their own chemical plants and refineries have entered the business. For example, Phillips Petroleum Co. owns Applied Automation, Bartlesville, Okla. Du Pont develops and produces materials analyzers through its analytical instrument division. Among engineering construction firms which install control systems in addition to building plants for process industries, Babcock & Wilcox, a subsidiary of McDermott, owns Bailey Controls Co., Wickliffe, Ohio. And Forney Engineering Co., Addison, Tex., is a subsidiary of Foster Wheeler Energy Corp.

Even if a large chemical company is not in the process control business, though, many design and build their own equipment when the market would be too small to interest a control equipment maker, or when the use is proprietary and the company wants to keep the project proprietary. For example, when microprocessors first appeared, Union Carbide's central engineering department, serving the chemical and plastics division worldwide for design and construction services, used one to make a microcomputer-guided controller based on a gas chromatographic (GC) analyzer at the department's shops in South Charleston, W.Va.

Similarly, when concern first arose about vinyl chloride, detectors for the monomer were unavailable commercially. The Carbide department de-

signed and installed monitors at company plants where the substance was used and coupled the monitors with computer-guided estimation of worker exposure over whole plant sites. When computer-based GC analyzer/controllers and vinyl chloride monitors became available commercially, the company's central engineering operation got out of the business.

Carbide's central engineering department still makes its own flowmeters and materials analyzers for certain proprietary catalyst streams. Measuring flow rates of gas-solid mixtures is a tough engineering problem, so the company devised its own solution. Because the catalysts are proprietary, Carbide has kept the materials anayzer needed to gauge catalyst activity to itself. Although not formally in the process control business, Carbide does build and sell a few, specialized devices as an accommodation to customers and some other buyers.

The technology edge of U.S. process control equipment firms traditionally has given this country a favorable balance of trade in such equipment. Predicasts expects this trend to continue over the next 15 years, though increasing use of electronic devices, coupled with Japanese advances in electronics, will lead to increasing penetration of the U.S. market by imports. Price competition by foreign valve makers also is expected to open the U.S. market further to imports.

Predicasts analysts see imports growing at slightly more than 15% annually, assuming 7% inflation rates. Predicasts data indicate the U.S. will import $216 million worth of process control equipment in 1981, or 3.8% of total sales here of $5.7 billion. Imports will grow to $380 million in 1985, the firm predicts, which will be 4% of the $9.5 billion market.

Exports will increase at 15.5% annually, Predicasts analysts say, again assuming 7% inflation. The company's data indicate that U.S. producers will export $758 million worth of process control equipment in 1981, amounting to 12.6% of their total sales. Exports will rise to $1.4 billion in 1985 to account for 13.4% of U.S. producers' sales.

Cost of process control for a chemical plant has averaged 9% of total capital investment, including hardware, engineering, and project management costs, for the past 10 years, industry analysts say. This expense ranges from 6% of capital investment for relatively uncomplicated plants to 15% in highly instrumented synfuels plants now being built.

This relative constancy of process control costs results from increased use of minicomputers and microprocessors as well as of electronic instruments with continually improving capacity. Thus companies are buying fewer components at higher prices to accomplish more in the way of control.

The installation of energy-efficient control systems at some plants does push the proportion toward 15% at some plants, according to C. Thomas Carroll, principal instrument engineer at Foster Wheeler Energy Corp., Livingston, N.J. Energy efficiency means lower allowed pressure drops, he says, which means specifying more accurate and, thus, more costly valves. The number of on/off valves in such a plant must be increased,

Preliminary Announcement and Call for Papers

16TH GREAT LAKES REGIONAL ACS MEETING

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Food and Agricultural Chemistry—E. Frankel, USDA Northern Labs

Inorganic Chemistry—D. Hendrickson, University of Illinois

Organic Chemistry—P. Johnson, Illinois Institute of Technology

Physical Chemistry—A. Trifunac, Argonne National Laboratory

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Great Lakes Region High School Teaching Award
Monday late afternoon—Beer Mixer

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ABSTRACT DEADLINE IS JANUARY 30, 1982.

Abstracts must be submitted on the standard ACS form with three copies to the Program Chairman.

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Determination of Toxic Organic Compounds Using Modern Chromatographic Methods, Biochemical Aspects of the Aging Process, Biomass Energy, Chemical Control of Insect Behavior, Natural Toxicants in Higher Plants, Cooperative Education in Chemistry, Natural Products, Primary Processes in Solution Photochemistry, Radiation Chemistry, Transient Intermediates in Biophysics, Transition Metal–Sulfur Interactions, High Energy Processes in Inorganic Systems, Mycotoxins, Chemical Demonstrations

Detach and return by January 4, 1982 to the General Chairman.

Name and Address *(abstract form requested ☐)*

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Papers to be presented _____

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Carroll says, because plant managers want to be able to shut down a plant with equipment still hot and materials recirculating in case of emergencies. Possible needs to operate plants at less than rated capacities and still conserve the use of energy, as in today's economic downturn, also lead to installation of more accurate, more expensive sensors such as flowmeters.

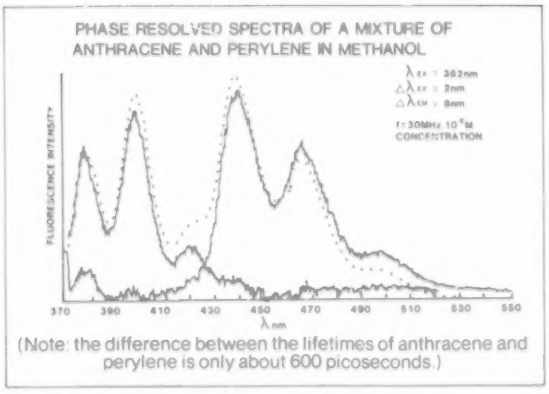
Besides more powerful electronic hardware, however, advances in process control theory also may contribute to keeping control costs down. Though control theory is always in advance of practice, W. Harmon Ray, chemical engineering professor at the University of Wisconsin, Madison, says that availability of increased, low-cost computing power makes it worthwhile to apply previously impractical concepts. Three areas where Ray foresees new applications of control theory are complete, centralized control of entire plant complexes; on-line production schedules at plants that use the same equipment to make many products; and use of functions based on partial differential equations rather than simple differential equations to describe what goes on in reactors.

Centralized control of plant complexes means that engineers must apply ideas on nonlinear interactions among different processes at the complex. In this way, plant managers can adjust the operating point of the entire complex continuously, Ray says, rather than concentrate on one or two critical points. In an ethylene plant, for example, managers can vary feedstocks to crack larger proportions of heavy liquids or add large amounts of butanes. They also can change relative amounts of products by adjusting furnace conditions. But Ray points out that these changes may alter such factors as rate of furnace coke buildup, and therefore maintenance costs. By improving the model of how the plant works, managers can find what are net economic consequences over long periods of decisions to change feedstocks or product slates.

Ray's second point, scheduling of production equipment use, already has been adopted to some extent by chemical firms here. Mallinckrodt uses such a system to schedule filling machine use to package the 200 or so reagent chemicals the company distributes from its Paris, Ky., plant (C&EN, Aug. 24, page 8). But Ray insists that such scheduling is not so widespread as it could be, and he points to development of computer programs by Swiss academicians for drug and dyes production as examples of what the future may hold.

Partial oxidation of hydrocarbons, as of naphthalene to phthalic anhydride, is an example of Ray's point that partial differential equations may find use to model such processes. Ray says these processes run close to thermal runaway, and that better modeling might bring greater efficiency through improved control. At present, he says, engineers consider only such simple parameters as change in reactor temperature with respect to time. A better model would combine equations describing, for example, change in temperature with respect to time, linear distance through the reactor, and radial distance from a central axis to the outer wall, with the other two factors held constant in each of the three functions. □

A NEW DIMENSION IN FLUORESCENCE MULTICOMPONENT ANALYSIS



(Note: the difference between the lifetimes of anthracene and perylene is only about 600 picoseconds.)

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